

A Study of Collecting Robot of Conifer Cone

Lu Huaimin (陆怀民) Yu Zunbo (于遵波) Liu Jinhao (刘晋浩)

Ge Anhua (葛安华) Yang Liping (杨丽萍)

Northeast Forestry University, Harbin 150040, China

Abstract The collecting robot of conifer cone mainly consists of walking mechanism and manipulator. Manipulator has 5 freedoms. The main technical parameters of this robot are as follows: maximum height of collecting is 14m, maximum radius of collecting is 68m, velocity of collecting is 0.65 m/s, and the maximum force of collecting is 2500N.

Key words: Conifer cone, Seed collecting, Robot

Introduction

In the forest production, the collection of conifer cone is always a difficult problem. Although many kinds of cone collecting machine have been researched and manufactured at home and abroad, for example, elevator, vibration machine of tree trunk and so on. These machines have not been applied widely because of many shortcomings. At present, in forest region, worker must climb up tree to collect conifer cones by hand with special tools. This collecting method is very dangerous to worker and damages mother tree seriously. To solve this problem, we researched and manufactured this collecting robot of conifer cone. The robot can collect conifer cones conveniently and safely with damage to the mother tree.

Structure of Robot

The robot is made up of manipulator, walking mechanism (skidding tractor J-50), hydraulic system and controlling system of microcomputer. The manipulator is made up of rotational disc, vertical pillar, lower arm, upper arm and collecting claw and so on. Manipulator has 5 freedoms. Collecting claw consists of two big comb-shape teeth which can open and close, and it can do pitching movement and swing movement. The hydraulic system of manipulator adopts a system of double pump and double circuit. The big pump provides oil for the cylinder of lower arm and hydraulic rotational motor of manipulator. The small pump provides oil for the cylinder of upper arm and the hydraulic components of collecting claw. Thus, lower arm and upper arm, or lower arm and collecting claw can move together. All hydraulic components are controlled by electromagnetic valves. Besides, in both tow circuits, servovalves are equipped, so that the moving direction and velocity of manipulator can be adjusted.

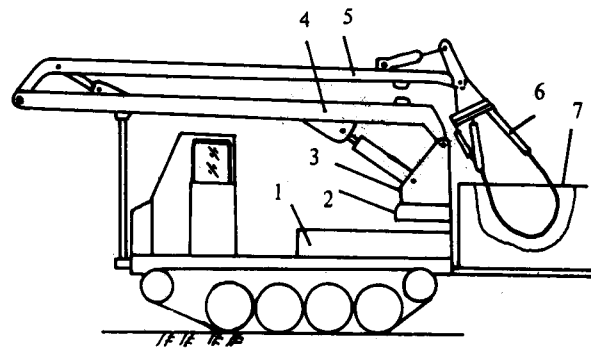


Figure. 1 Outline of collecting robot

1. tractor 2. rotational disc 3. vertical pillar 4. lower arm
5. upper arm 6. collecting claw 7. cone case

All valves of hydraulic system are controlled by a microcomputer system. Microcomputer system consists of two parts: main part and hand part. Main part is mounted on manipulator's rotational disc, and hand part is fixed in a box, these two parts are communicated by a piece of cable. A worker stands on the ground to operate this robot to collect conifer cone by handling this control box.

Main technical Parameters

maximum height of collecting	14m
minimum height of collecting	3m
maximum radius of collecting	6.8 cm
maximum collecting force of collecting claw	2500N
maximum collecting velocity of collecting claw	0.65m/s
rotational velocity of manipulator	0.55r/m
maximum walking velocity of Robot	10.3 km/h

weight of Robot	8750 kg
size of outline	7120×2000×3130 mm
maximum slope of working condition	12
working voltage	24v
pressure of hydraulic system	16 MPa
flow of hydraulic system	16/10 mL/r

Collecting Process

First, operator drives robot and makes it stop 3-5 m away from mother tree, then operates manipulator to aim at this tree and raises lower arm and upper arm together, opens collecting claw and moves it 1.5-2 m toward a bough, closes claw round the bough and moves back, thus the conifer cones may be combed down. Under the controlling of microcomputer, the claw moves up or down to aim at another bough, and repeats the above-mentioned collecting actions. After collecting several

boughs, microcomputer controls manipulator to dump cones into the cone case. In one site of robot standing, all the trees around the robot may be collected easily.

Test and Conclusion

The practical test shows that the collecting robot can collect 500 kg larch cone per day, and its efficiency is about 30-35 times than a worker climbing the tree to pick cones. Besides, if the distance of comb teeth is adjusted, the robot can collect other kind conifer cone. Using this robot, a great deal of conifer cones may be collected on the promise almost of no damaging to the mother trees. There will be a important significance in environmental protection of forest ecology, forest regeneration, reducing the labour strength of worker and raising the efficiency of seed collecting. So the robot may be applied widely in forest production.

(Responsible Editor: Dai Fangtian)